



UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

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First Named Inventor or Application Identifier

MASAMINE MAEDA, ET AL.

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APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:

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1. ☒ Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. ☒ Specification Total Pages
3. ☒ Drawing(s) (35 USC 113) Total Sheets
4. ☒ Oath or Declaration Total Pages
- a. ☐ Newly executed (original or copy)
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- c. ☒ Copy from a prior application (37 CFR 1.63(d))
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[Note Box 5 below]
- i. ☐ DELETION OF INVENTOR(S)
Signed Statement attached deleting inventor(s)
named in the prior application, see 37 CFR
1.63(d)(2) and 1.33(b).
5. ☒ Incorporation By Reference (useable if Box 4c is checked)
The entire disclosure of the prior application, from which a copy of the
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part of the disclosure of the accompanying application and is hereby
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6. ☐ Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission
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ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement (when there is an assignee) ☐ Power of Attorney
10. ☐ English Translation Document (if applicable)
11. ☒ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
12. ☒ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)
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14. ☐ Small Entity Statement(s) ☐ Statement filed in prior application
Status still proper and desired
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17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☒ Divisional ☐ Continuation-in-part (CIP) of prior application No. 08 / 841,564, filed April 30, 1997

18. CORRESPONDENCE ADDRESS

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CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	1 -20 =	0	X \$ 18.00 =	\$000.00
	INDEPENDENT CLAIMS (37 cfr 1.16(b))	1 -3 =	0	X \$ 78.00 =	\$000.00
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			\$260.00 =	\$000.00
				BASIC FEE (37 CFR 1.16(a))	\$690.00
	Total of above Calculations =				\$690.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				
	TOTAL =				\$690.00

19. Small entity status

- a. ☐ A Small entity statement is enclosed
- b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
- c. ☐ Is no longer claimed.

20. ☒ A check in the amount of \$ 690.00 to cover the filing fee is enclosed.

21. ☐ A check in the amount of \$ _____ to cover the recordal fee is enclosed.

22. The Commissioner is hereby authorized to credit any overpayments or charge any deficiencies to Deposit Account No. 06-1205:

- a. ☒ Fees required under 37 CFR 1.16.
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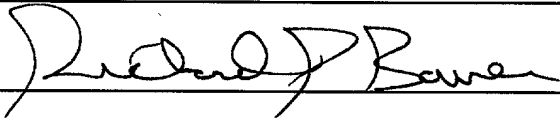
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Image Pickup System With Separable/attachable Image
Pickup Device And Display Device

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to an image pickup device adapted for use in a camcorder (camera-integrated video cassette recorder), a display device for displaying the picked-up image, and an image pickup system consisting of the image pickup device and the display device.

Related Background Art

In the conventional camcorder (camera-integrated video cassette recorder), an image pickup unit and an image display unit including a monitor and a VCR (video cassette recorder) are mutually inseparably integrated. For this reason, in case of image pickup by placing such camcorder in a place unreachable by the photographer, the image to be picked-up cannot be confirmed on the monitor.

For avoiding such drawback, there has been known a camcorder in which an image pickup unit and an image display unit are separated as shown in Fig. 14.

In Fig. 14, there are shown an image pickup unit 10, an image display unit 11, a lens 1 for forming the image of an object, an image pickup device 2 for converting the formed image of the object into an image

signal, a CDS/AGC circuit 3 for effecting sample holding of the image signal, thereby obtaining an appropriate signal level, a digital signal processing unit 4 for effecting A/D conversion on the image signal from the CDS/AGC circuit 3 and effecting digital signal processing, an NTSC encoder 5 for converting the digital image signal from the digital signal processing circuit 4 into an NTSC image signal, a cable 6 connecting the image pickup unit 10 and the image display unit 11, a monitor 7 for displaying the NTSC image signal supplied from the image pickup unit 10 or reproduced from a recording medium to be explained later, a recording/reproducing unit 8 for recording the NTSC image signal from the image pickup unit 10 on a recording medium or reproducing such signal from the recording medium, and attaching/detaching means 9a, 9b for mechanically attaching or detaching the image pickup unit 10 and the image display unit 11.

In such configuration, the image pickup operation by the image pickup unit 10 can be made while the image display unit 11 is separated, and both can be united in use, if necessary, by the attaching/detaching means 9a, 9b.

In such conventional camcorder, however, a cable is extended from the image pickup unit and hinders the freedom of image pickup operation.

SUMMARY OF THE INVENTION

In consideration of the foregoing, an object of the present invention is to separate the image pickup unit and the image display unit in mutually separable and unitable manner, thereby increasing the freedom in the image pickup operation.

Another object of the present invention is to avoid increase of the electric power consumption in attaining the above-mentioned object.

Still another object of the present invention is to achieve efficient image transmission from the image pickup unit to the image display unit.

The above-mentioned objects can be attained, according to the present invention, by an image pickup device comprising image pickup means for pickup the image of an object and outputting image data, first compression encoding means for compression encoding of the image data, wireless transmission means for modulating thus compression encoded image data for transmission to a wireless transmission channel, and connection means adapted to be mechanically and electrically connected in detachable manner to a display device for displaying the image picked-up by the image pickup device and to transmit the above-mentioned image data from the image pickup means.

Also according to the present invention, there is provided a display device comprising wireless reception

means for receiving and demodulating the compression
encoded and modulated image data from the wireless
transmission channel, first expansion means for
expanding thus demodulated image data thereby obtaining
5 first image data, connection means adapted to be
mechanically and electrically connected in detachable
manner to the image taking device and to receive second
image data from the image pickup device, signal
processing means for selectively receiving the first
10 and second image data and processing thus received
image data to output an image signal of a predetermined
system, and display means for displaying the image
signal of the above-mentioned predetermined system.

Also according to the present invention, there is
15 provided an image pickup system comprising an image
pickup device including image taking means for taking
the image of an object and outputting image data,
compression encoding means for compression encoding of
the image data, wireless transmission means for
20 modulating thus compression encoded image data for
transmission to wireless transmission channel, and
first connection means adapted to be mechanically and
electrically connected in detachable manner to a
display device for displaying the image picked-up by
25 the image pickup device and to transmit the above-
mentioned image data from the image pickup means; and a
display device including wireless reception means for

receiving and demodulating the transmitted image data
from the wireless transmission channel, expansion means
for expanding thus demodulated image data thereby
obtaining first image data, second connection means
5 adapted to be mechanically and electrically connected
in detachable manner to the first connection means and
to receive second image data from the image pickup
device, signal processing means for selectively
receiving the first and second image data and
10 processing thus received image data to output an image
signal of a predetermined system, and display means for
displaying the image signal of the above-mentioned
predetermined system.

15 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an image pickup
unit in a first embodiment of the present invention;

Fig. 2 is a block diagram showing an image display
unit in the first embodiment;

20 Fig. 3 is a block diagram showing an image taking
unit in a second, third or fifth embodiment;

Fig. 4 is a block diagram showing an image display
unit in the second embodiment;

Fig. 5 is a block diagram showing a JPEG image
25 compression circuit;

Fig. 6 is a block diagram showing a JPEG image
expansion circuit;

Fig. 7 is a block diagram showing a DV image compression circuit:

Fig. 8 is a block diagram showing an image display unit in the third embodiment;

5 Fig. 9 is a block diagram showing an image taking unit in a fourth embodiment;

Fig. 10 is a block diagram showing an image display unit in the fourth embodiment;

10 Fig. 11 is a block diagram of an MPEG image compression circuit;

Fig. 12 is a block diagram of an MPEG image expansion circuit;

Fig. 13 is a block diagram showing an image display unit in the fifth embodiment; and

15 Fig. 14 is a block diagram of a conventional camcorder.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 In the following there will be explained first to fifth embodiments in which the present invention is applied to a camcorder, with reference to the attached drawings. In Figs. 1 to 13, mutually corresponding components are represented by a same number and will not be explained repeatedly.

25 Fig. 1 is a block diagram of an image pickup unit 100 of a camcorder in a first embodiment of the present invention, and Fig. 2 is an image display unit 200 of

the camcorder.

In the image pickup unit 100 shown in Fig. 1, there are provided a lens 101 for forming the image of an object, an image pickup device 102 for converting thus formed image into an image signal, a CDS/AGC circuit 103 for effecting sample holding on the image signal thereby providing an appropriate signal level, a digital signal processing circuit 104 for A/D conversion of the image signal from the CDS/AGC circuit 103 and digital signal processing, an image compression circuit 105 for compression encoding of the digital image signal from the digital signal processing circuit 104, a spectrum diffusion transmission circuit 106 for transmitting the compressed image data from the image compression circuit 105 by spectrum diffusion modulation, and a transmitting antenna 107.

There are also provided a microcomputer 108, a power source 109, a power source control unit 110 for on/off control of the power supply to various units according to commands from the microcomputer 108, a joining detection device 112 for detecting that an image display unit 200 to be explained later is coupled, a signal connection device 113 for connecting the digital signal processing circuit 104 with the image display unit 200 when it is coupled, and an attaching/detaching device 114 including the joining detection device 112 and the signal connection device

113 and adapted to electrically and mechanically connect, in detachable manner, to the image display unit 200.

In the image display unit 200 shown in Fig. 2,
5 there are provided a receiving antenna 201, a spectrum diffusion reception unit 202 for receiving the image data transmitted from the image pickup unit 100 and effecting demodulation to restore the compressed image data, an image expansion unit 203 for expanding the
10 compressed image data to obtain the digital image signal, an NTSC encoder 204 for converting the digital image signal into the NTSC image signal, a recording/reproducing unit 205 for recording and reproducing the NTSC image signal, a recording medium
15 206, and a monitor 207 for displaying the NTSC image signal.

There are also provided a microcomputer 208, a power source 209, a power source control unit 110 for on/off control of the power supply to various unit
20 according to commands from the microcomputer 208, a joining detection device 211 for detecting that the image display unit 100 is coupled, a signal connection device 212 for connecting the NTSC encoder 204 with the image pickup unit 100 when it is coupled, and an
25 attaching/detaching device 213 including the joining detection device 211 and the signal connection device 212 and adapted to electrically and mechanically

connect, in detachable manner, to the image pickup unit 100.

The image compression circuit 105 mentioned above can also be a pixel thinning-out circuit for processing the digital image signal from the digital signal processing circuit 104 in the unit of each pixel and reducing the number of pixels by pixel thinning-out. Also the image expansion circuit 203 mentioned above can also be a pixel interpolation circuit for processing the digital image signal from the spectrum diffusion reception unit 202 in the unit of each pixel to effect interpolation of the pixels.

In the above-explained configuration, when the image pickup unit 100 and the image display unit 200 are mutually separated, the image picked-up by the image pickup unit 100 is transmitted by wireless transmission to the image display unit 200 in a distant location and can be monitored and/or recorded and reproduced therein. Consequently the photographer can place the image pickup unit 100 in a distant location, without being concerned with the location of the image display unit 200, whereby freedom of the image pickup operation can be increased. It is also possible to take out the picked-up image from the signal connection device 113 and send it to an external equipment such as a computer. It is furthermore possible to supply the signal connecting device 212 of the image display unit

200 with the image signal from an external equipment,
thereby monitoring and/or recording and reproducing
such image signal.

In such case, the joining detection devices 112,
5 211 do not detect the coupled state, so that the
microcomputers 108, 208 supply the power source control
units 110, 210 with commands to feed electric power to
all the units.

On the other hand, in case the image pickup unit
10 100 and the image display unit 200 are integrally
coupled by connection through the attaching/detaching
devices 114, 213, the joining detection devices 112,
211 detects such coupled state, whereby the
microcomputers 108, 208 supply the power source control
15 units 110, 210 with commands to terminal power supply
to the spectrum diffusion transmission unit 106, the
spectrum diffusion reception unit 202, the image
compression circuit 105 and the image expansion circuit
203 whereupon the power supply to these circuits is
20 terminated. In this manner the electric power
consumption can be reduced in the coupled state.

In case the both units are mutually separated, the
image signal is transmitted with a reduced data amount
obtained by compression, so that it can be transmitted
25 without difficulty even by wireless digital
transmission which is limited in the transmission rate.
Also the use of the spectrum diffusion modulation

allows transmission of the signal of a wide band with a limited electric power. On the other hand, in case the both units are mutually coupled, a high image quality can be obtained since the image signal is transmitted without compression.

In the following there will be explained a second embodiment.

The present embodiment employs, for the image compression, the JPEG compression method and the DV compression method. The JPEG compression method, capable of achieving a high compression rate for the image data, is suitable for image transmission in the wireless transmission channel limited in the transmission rate. The JPEG compression method is often employed in the personal computers as the image data format.

On the other hand, the DV compression method is widely employed in the digital CVR because of very high image quality, though the image data compression rate is not so high.

Fig. 3 shows the image pickup unit 100 in the second embodiment, and Fig. 4 shows the image display unit 200 therein.

In the image taking unit 100 shown in Fig. 3, there are provided a JPEG image compression circuit 115 for compressing, in the JPEG method, the digital image signal from the digital signal processing circuit 104,

a DV image compression circuit 116 for compressing, in the DV method, the digital image signal from the digital signal processing circuit 104, a compression method selecting switch 117 for connecting the digital signal processing circuit 104 to the JPEG image compression circuit 115 or the DV image compression circuit 116 according to a command from the microcomputer 108, and a compression method selecting switch 118 shifted in linkage with the switch 117, for connecting the signal connecting device 113 to the JPEG image compression circuit 115 or the DV image compression circuit 116.

In the image display unit 200 shown in Fig. 4, there are provided a JPEG image expansion circuit 214 for expanding the JPEG compressed image to restore the digital image signal, a DV image compression circuit 215 for compressing, by the DV method, the digital image signal from the JPEG image compression circuit 214, a DV image expansion circuit 216 for expanding the DV compressed image data from the signal connecting device 212 to restore the digital image signal, a digital recording/reproducing unit 217 for digital recording and reproduction of the DV compressed image data on or from the recording medium 206, and an image selecting switch 218 for connecting the digital recording/reproducing unit 217 to the DV image compression circuit 215 or the signal connecting device

212 according to the command from the microcomputer 208.

In the above-explained configuration, when the image pickup unit 100 and the image display unit 200 are mutually separated, the joining detection devices 112, 211 do not detect the coupled state, so that the microcomputers 108 of the image pickup unit 100 instructs the switch 117 to connect the digital signal processing circuit 104 to the JPEG image compression circuit 115. Also linked with the switch 117, the switch 118 connects the signal connecting device 113 to the JPEG image compression circuit 115. On the other hand, the microcomputer 208 of the image display unit 200 instructs the switch 218 to connect the digital recording/reproducing unit 217 to the DV image compression circuit 215.

In this state, the signal flows along paths of lens 101 → image pickup device 102 → CDS/AGC circuit 103 → digital signal processing circuit 104 → switch 117 → JPEG image compression circuit 115 → spectrum diffusion transmission unit 106 → transmitting antenna 107 → receiving antenna 201 → spectrum diffusion reception unit 202 → JPEG image expansion circuit 214 → DV image compression circuit 215 → switch 218 → digital recording/reproducing unit 217 → recording medium 206, and of JPEG image expansion circuit 214 → NTSC encoder 204 → monitor 207.

The JPEG compressed signal is released from the JPEG image compression circuit 115 through the switch 118 to the signal connecting device 113, it can be transmitted for example to the computer. Also the
5 external DV compressed signal can be supplied to the image display unit 200 through the signal connecting device 212.

At the reproducing operation, the microcomputer 208 instructs the switch 218 to connect the digital
10 recording/reproducing unit 217 to the DV image expansion circuit 216. In this state the signal flows along a path of recording medium 206 → digital recording/reproducing unit 217 → switch 218 → DV image expansion circuit 216 → NTSC encoder 204 → monitor 207.

15 On the other hand, when the image pickup unit 100 and the image display unit 200 are integrally coupled, the joining detection devices 112, 211 detect the coupled state. The microcomputer 108 of the image pickup unit 100 instructs the switch 117 to connect the
20 digital signal processing circuit 104 to the DV image compression circuit 116. Linked with the switch 117, the switch 118 connects the signal connecting device 113 to the DV image compression circuit 116. On the other hand, the microcomputer 208 of the image display
25 unit 200 instructs the switch image selecting switch 218 to connect the digital recording/reproducing unit 217 to the signal connecting device 212.

In this state, the signal flows along paths of lens 101 → image pickup device 102 → CDS/AGC circuit 103 → digital signal processing circuit 104 → switch 117 → DV image compression circuit 116 → switch 118 → signal connecting device 113 → signal connecting device 212 → switch 218 → digital recording/reproducing unit 217 → recording medium 206, and of signal connecting device 212 → DV image expansion circuit 216 → NTSC encoder 204 → monitor 207.

In the reproducing operation, the signal flows along a path of recording medium 206 → digital recording/reproducing unit 217 → switch 218 → DV image expansion circuit 216 → NTSC encoder 204 → monitor 207.

In the present embodiment explained above, when the image pickup unit 100 and the image display unit 200 are separated, the JPEG method is selected for image compression, whereby the wireless transmission can be achieved in efficient manner.

When the image taking unit 100 and the image display unit 200 are integrally coupled, the DV method is selected for image compression, thereby achieving digital image recording of high image quality.

Fig. 5 is a block diagram showing the configuration of the JPEG image compression circuit 115 in Fig. 3, wherein provided are a raster-block conversion unit 301, a DCT (discrete cosine transformation) unit 302, a quantization unit 303, a

Huffman encoding unit 304, a quantization table 305 to be used in the quantization unit 303, and a Huffman table 306 to be used in the Huffman encoding unit 304.

5 In the JPEG image compression circuit 115 of the above-explained configuration, the input digital image signal consisting of luminance/color difference signals of raster format is divided by the raster block conversion unit 301 into blocks of 8x8 pixels, each represented by an 8x8 square matrix. Then the DCT unit
10 302 executes a DCT process (discrete cosine transformation) on the 8x8 matrix data. The transformed data, called DCT coefficients, are also 8x8 matrix data of which terms at the upper left part represent the magnitudes of the low frequency
15 components of the original image while those at the lower right part represent the magnitudes of the high frequency components of the original image.

Then the quantization unit 303 executes divisions of the data in the above-mentioned matrix respectively,
20 utilizing a coefficient table called the quantization table 305. The quantization table 305 is weighted in the high frequency components with respect to the low frequency components, so that the results of the divisions constitute matrix data of which values
25 decrease progressively toward the higher frequency. Subsequently there is executed quantization to reduce the values less than a predetermined value to zero,

whereby most values in the lower right part of the matrix data become zero.

Then the above-mentioned matrix data are arranged as a data train in an order called zigzag scan, and are subjected to a transformation called Huffman encoding in the Huffman encoding unit 304. This transformation replaces a redundant portion of the data (a data portion where a same value appears in continuation). In the above-mentioned data train, the portion with value 0 in continuation is significantly shortened, whereby the amount of the image data is compressed.

Fig. 6 is a block diagram showing the configuration of the JPEG image expansion circuit 214 in Fig. 4, wherein provided a Huffman decoding unit 401, a Huffman table 402 to be used in the Huffman decoding unit 401, an inverse quantization unit 403, a quantization table 404 for be used in the inverse quantization unit 403, an inverse DCT unit 405, and a block-raster conversion unit 406.

In the JPEG image expansion circuit 214 of the above-explained configuration, the input JPEG compressed image signal is subjected to Huffman decoding in the Huffman decoding unit 401 to provide the original data train. This data train is returned to the matrix data, which are subjected to multiplications in the inverse quantization unit 403 based on the quantization table 404. The matrix data

obtained in this state contain a larger number of 0 in the higher frequency components, in comparison with the aforementioned DCT coefficients. Then the inverse DCT unit 405 executes an inverse DCT and the block-raster conversion unit 406 rearranges the blocks in the original order, thereby providing the expanded digital image.

Fig. 7 shows the configuration of the DV image compression circuit 215 in Fig. 4, wherein provided a block division shuffling circuit 501, a DCT operation weighing circuit 502, a rearrangement circuit 503, an adaptive quantization circuit 504, a variable length encoding circuit 505, a deshuffling circuit 506, a motion detection circuit 507 and a code amount estimation circuit 508.

In the configuration explained above, the data with converted transmission rate are converted, in the block division shuffling circuit 501, into blocks of 8x8 pixels each, in each of the luminance signal and the two color difference signals, and a macroblock is constituted by six blocks consisting of four Y signal blocks and two color difference signal blocks. The divided data are then subjected to a rearrangement of the positions on the image in order to average the amount of information constituting the portion of a fixed length, and are subjected to the DCT operation (discrete cosine transformation) in the DCT operation

weighing circuit 502. In this operation, an image with
a large amount of motion is processed within a frame,
and the motion detection circuit 507 is provided for
this purpose. After the DCT operation, the data are
5 weighted, rearranged by the rearrangement circuit 503,
and quantized by the adaptive quantization circuit 504.
The quantized data are subjected to variable length
coding (VLC) in the variable length encoding circuit
505, in such a manner that the amount of codes after
10 variable length encoding becomes constant for every
macroblock, by estimating the amount of codes at the
quantization. The encoded data are outputted after
being returned to the original position in the image.
The output digital signal is given an error correction
15 code, and deshuffled by the deshuffling circuit 506,
whereby compressed data are outputted.

In the following there will be explained a third
embodiment.

In this embodiment, the image pickup unit 100 is
20 identical, in configuration, with that shown in Fig. 3
in the second embodiment, but the image display unit
200 has a configuration shown in Fig. 8, which is
different in the arrangement of the various units from
that shown in Fig. 4.

25 In the above-mentioned configuration, when the
image pickup unit 100 and the image display unit 200
are mutually separated, the signal flows along paths of

lens 101 → image pickup device 102 → CDS/AGC circuit
103 → digital signal processing circuit 104 → switch
117 → JPEG image compression circuit 115 → spectrum
diffusion transmission unit 106 → transmitting antenna
5 107 → receiving antenna 201 → spectrum diffusion
reception unit 202 → JPEG image expansion circuit 214 →
DV image compression circuit 215 → switch 218 → digital
recording/reproducing unit 217 → recording medium 206,
and of switch 218 → DV image expansion circuit 216 →
10 NTSC encoder 204 → monitor 207.

At the reproducing operation, the signal flows
along a path of recording medium 206 → digital
recording/reproducing unit 217 → DV image expansion
circuit 216 → NTSC encoder 204 → monitor 207.

15 On the other hand, when the image pickup unit 100
and the image display unit 200 are integrally coupled,
the signal flows along paths of lens 101 → image pickup
device 102 → CDS/AGC circuit 103 → digital signal
processing circuit 104 → switch 117 → DV image
20 compression circuit 116 → switch 118 → signal
connecting device 113 → signal connecting device 212 →
switch 218 → digital recording/reproducing unit 217 →
recording medium 206, and of switch 218 → DV image
expansion circuit 216 → NTSC encoder 204 → monitor 207.

25 At the reproducing operation, the signal flows
along a path of recording medium 206 → digital
recording/reproducing unit 217 → DV image expansion

circuit 216 → NTSC encoder 204 → monitor 207.

In the following there will be explained a fourth embodiment.

This embodiment employs MPEG compression method
5 instead of the JPEG compression method in the second
and third embodiments. Consequently the image pickup
unit 100 is provided, as shown in Fig. 9, with an MPEG
image compression circuit 119, and the image display
unit 200 is provided, as shown in Fig. 10, with an MPEG
10 image expansion circuit 219. The remaining parts in
Fig. 9 correspond to those in Fig. 3, and the remaining
parts in Fig. 10 correspond to those in Fig. 4. Also
the signal paths in the recording and reproducing
operations are similar to those in the configurations
15 shown in Figs. 3 and 4.

Fig. 11 is a block diagram showing the
configuration of the MPEG image compression circuit
119, wherein provided are an information source encoder
801 for compressing the amount of input information by
20 effecting the aforementioned DCT, quantization etc., a
video signal multiplexer 802 for converting thus
compressed data into data based on the MPEG format, a
transmission buffer 803 for transmitting the data of
the above-mentioned format at a predetermined data
25 rate, and an encoding controller 804 for increasing or
decreasing the amount of the generated information.

Fig. 12 is a block diagram showing the

configuration of the MPEG image expansion circuit 219,
wherein provided are a reception buffer 901 for
securing a decoding process time for the received data,
a video signal demultiplexer 902 for extracting the
5 compressed data from the received format data, and an
information source decoder 903 for restoring the
original image signal by inverse quantization, inverse
DCT etc.

The MPEG compression method is featured by
10 executing, in the information source encoder 801, an
anticipated encoding of representing the object image
in the form of the difference from a past image or the
difference from an anticipated image estimated from the
past image, in addition to the aforementioned DCT and
15 quantization, and can provide a higher compression
rate, in comparison with the JPEG method which provides
a series of compressed images each completed within an
image frame.

In the following there will be explained a fifth
20 embodiment.

This embodiment employs the MPEG compression
method in the third embodiment shown in Fig. 8, instead
of the JPEG compression method therein. Consequently
the image display unit 200 is provided with an MPEG
25 image expansion circuit 219 but is same in other parts
as the configuration shown in Fig. 8. The image pickup
unit 100 is same as that shown in Fig. 9. Also the

signal flow paths in the recording and reproducing operations are same as those in the third embodiment.

In the foregoing embodiments, when the image pickup device and the image display device are mutually separated, the image pickup device can send the compression encoded image data to the image display device by wireless transmission, without the connecting cable and with a reduced data amount, whereby the freedom of the image pickup operation can be increased.

Also when the image pickup device and the image display device are integrally coupled through the connection means, the image pickup device can directly transmit the image data through the connection means.

Also satisfactory image transmission can be achieved by selecting two suitable compression methods. In particular, the JPEG compression method enables efficient transmission when the image pickup device and the image display device are mutually separated, and the DV compression method allows to improve the image quality when the devices are integrally coupled.

Also the electric power consumption can be saved by interrupting the power supply to the unnecessary circuits, when the devices are integrally coupled.

It is also rendered possible, in the separated state of the devices, to send the image data to an external equipment from the connection means of the image pickup device, and to supply the connection means

of the image display device with external image data
and to display such image data.

Many widely different embodiments of the present
invention may be constructed without departing from the
5 spirit and scope of the present invention. It should
be understood that the present invention is not limited
to the specific embodiments described in the
specification, except as defined in the appended
claims.

WHAT IS CLAIMED IS:

1. An image pickup device comprising:

image pickup means for pickup the image of an object and outputting image data;

5 first compression encoding means for effecting compression encoding of said image data;

wireless transmission means for modulating said compression encoded image data and transmitting said data to a wireless transmission channel; and

10 connection means adapted to be electrically and mechanically connected, in detachable manner, to a display device for displaying the image picked-up by said image pickup means and to transmit said image data from said image pickup means.

15

2. An image pickup device according to claim 1, wherein:

said first compression encoding means is adapted to effect compression encoding of said image data with
20 a first compression method and to output first image data for supply to said wireless transmission channel; and said image pickup device further comprising:

second compression encoding means for effecting compression encoding of said image data from said image
25 pickup means by a second compression method;

detection means for detecting that said display device is connected to said connection means; and

selection means for selecting said second
compression encoding means, upon detection of the
connection of said display device, thereby providing
said connection means with said second image data.

5

3. An image pickup device according to claim 2,
wherein said selection means is adapted, when the
connection of said display device is not detected, to
provide said connection means with said first image
data.

10

4. An image pickup device according to claim 2,
wherein said first compression method is the JPEG
compression method and said second compression method
is the DV compression method.

15

5. An image pickup device according to claim 2,
wherein said first compression method is the MPEG
compression method and said second compression method
is the DV compression method.

20

6. An image pickup device according to claim 1,
further comprising control means adapted to detect that
said display device is connected to said connection
means, and, in response to said detection, to restrict
the supply of power to said first compression encoding
means and said wireless transmission means.

25

7. An image pickup device according to claim 1, wherein said wireless transmission means is adapted to effect spectrum diffusion modulation on said image data.

5

8. An image pickup device according to claim 1, wherein said first compression encoding means is adapted to compress the image data by a thinning-out process.

10

9. A display device comprising:

wireless reception means for receiving the compression encoded and modulated image data from a wireless transmission channel and demodulating said image data;

15

first expansion means for expanding said demodulated image data to obtain first image data;

connection means adapted to be electrically and mechanically connected, in a detachable manner, to an image pickup device and to receive second image data from said image pickup device;

20

signal processing means for selectively receiving said first or second image data and processing said received image data to output an image signal of a predetermined format; and

25

display means for displaying the image signal of said predetermined format.

10. A display device according to claim 9,
wherein said first image data are obtained by
compression encoding with a first compression method,
while said second image data are obtained by
5 compression encoding with a second compression method,
and said display device further comprising:

second expansion means for expanding said second
image data and providing said signal processing means
with said second image data selectively with said first
10 image data.

11. A display device according to claim 9,
further comprising recording and/or reproducing means
for recording and/or reproducing the image signal
15 obtained from said signal processing means on or from a
recording medium.

12. A display device according to claim 10,
further comprising:
20 compression encoding means for effecting
compression encoding of said first image data, obtained
from said first expansion means, with said second
compression method;

detection means for detecting that said image
25 pickup device is connected to said connection means;

selection means for selecting said second image
data from said connection means in case the connection

of said image pickup device is detected, or the image data from said compression encoding means in case said connection is not detected; and

5 recording and/or reproducing means for recording and/or reproducing said selected image data on and/or from a recording medium.

13. A display device according to claim 9,
wherein said first image data are obtained by
10 compression encoding with a first compression method, while said second image data are obtained by compression encoding with a second compression method, and said display device further comprising:

15 compression encoding means for effecting compression encoding of said first image data, obtained from said first expansion means, with said second compression method;

detection means for detecting that said image pickup device is connected to said connection means;

20 selection means for selecting the image data from said connection means in case the connection of said image pickup device is detected, or the image data from said compression encoding means in case said connection is not detected; and

25 third expansion means for expanding said selected image data and providing said signal processing means with said expanded image data.

14. A display device according to claim 13,
further comprising recording/reproducing means for
recording or reproducing said selected image data on or
from a recording medium.

5

15. A display device according to claim 9,
further comprising control means adapted to detect that
said image pickup device is connected to said
connection means, and, in response to said detection,
10 to terminate the supply of power to said wireless
reception means and said expansion means.

16. A display device according to claim 10,
further comprising control means adapted to detect that
15 said image pickup device is connected to said
connection means, and, in response to said detection,
to terminate the supply of power to said wireless
reception means and said expansion means.

20 17. A display device according to claim 10,
wherein said first compression method is the JPEG
compression method and said second compression method
is the DV compression method.

25 18. A display device according to claim 13,
wherein said first compression method is the JPEG
compression method and said second compression method

is the DV compression method.

19. A display device according to claim 10,
wherein said first compression method is the MPEG
5 compression method and said second compression method
is the DV compression method.

20. A display device according to claim 13,
wherein said first compression method is the MPEG
10 compression method and said second compression method
is the DV compression method.

21. A display device according to claim 9,
wherein said wireless reception means is adapted to
15 demodulate image data subjected to spectrum diffusion
modulation.

22. A display device according to claim 9,
wherein said demodulated image data are image data
20 compressed by thinning-out, and said first expansion
means is adapted to expand said image data by
interpolation.

23. A display device according to claim 9,
25 wherein said signal processing means is adapted to
output an image signal of NTSC system.

24. An image pickup system comprising an image pickup device including image pickup means for pickup the image of an object and outputting image data; compression encoding means for effecting compression encoding of said image data; wireless transmission means for modulating said compression encoded image data and transmitting said data to a wireless transmission channel; and first connection means adapted to be electrically and mechanically connected, in detachable manner, to a display device for displaying the image pickup by said image pickup means and to transmit said image data from said image pickup means; and a display device including wireless reception means for receiving said transmitted image data from said wireless transmission channel and demodulating said image data; expansion means for expanding said demodulated image data to obtain first image data; second connection means adapted to be electrically and mechanically connected, in a detachable manner, to said first connection means and to receive second image data from said image pickup device; signal processing means for selectively receiving said first or second image data and processing said received image data to output an image signal of a predetermined format; and display means for displaying the image signal of said predetermined format.

ABSTRACT OF THE DISCLOSURE

An image pickup system comprising an image pickup device including an image pickup element for pickup the image of an object and outputting image data, a
5 compression encoding circuit for effecting compression encoding of the image data, a wireless transmission circuit for modulating the compression encoded image data and transmitting the data to a wireless transmission channel, and a first connector adapted to
10 be electrically and mechanically connected, in detachable manner, to a display device for displaying the image picked-up by the image pickup element and to transmit the image data from the image pickup element; and a display device including a wireless reception
15 circuit for receiving the transmitted image data from the wireless transmission channel and demodulating the image data, an expansion circuit for expanding the demodulated image data to obtain first image data, a second connector adapted to be electrically and
20 mechanically connected, in a detachable manner, to the first connector and to receive second image data from the image pickup device, a signal processing circuit for selectively receiving the first or second image data and processing the received image data to output
25 an image signal of a predetermined format, and a monitor for displaying the image signal of the predetermined format.

FIG. 1

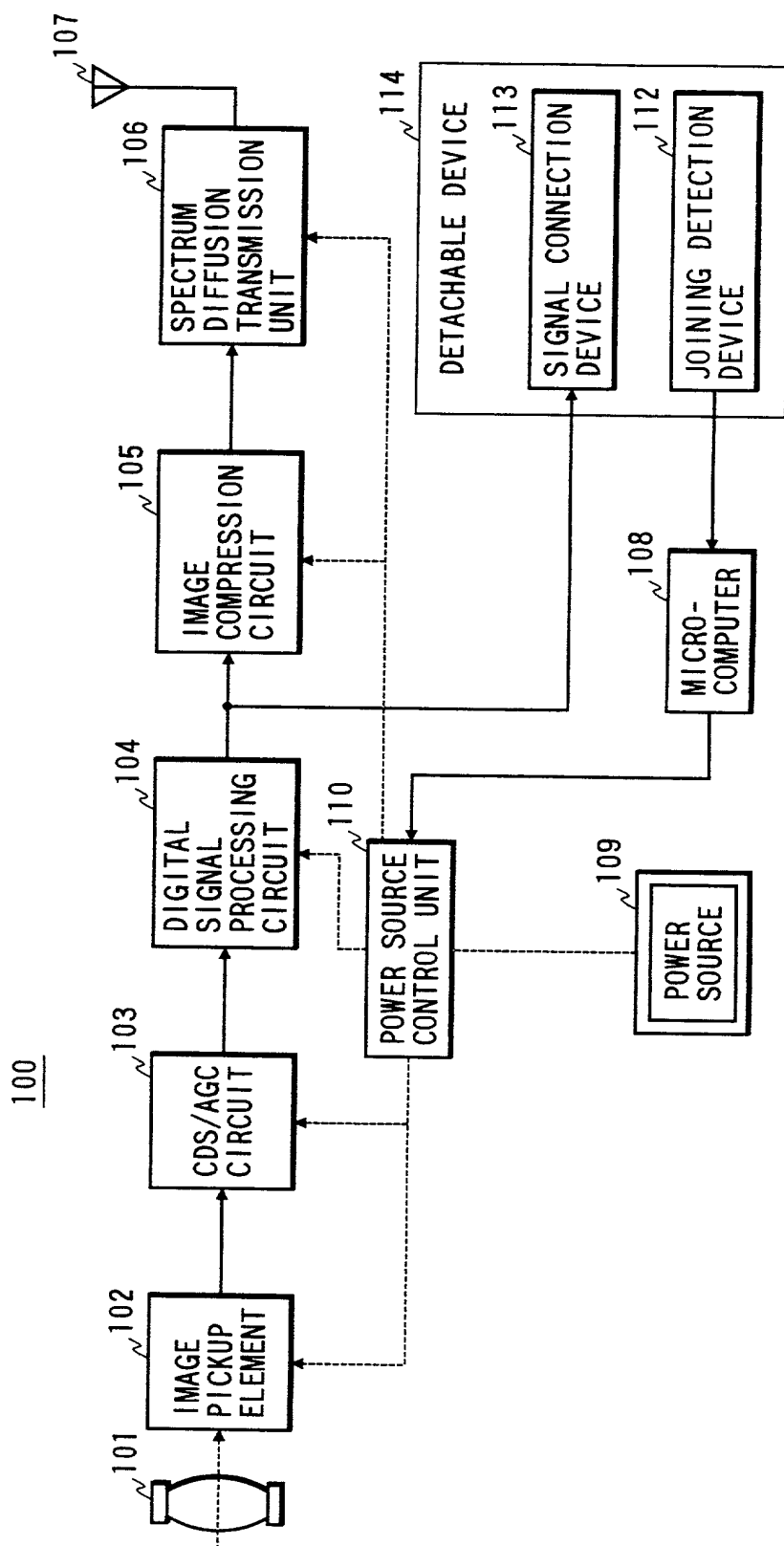


FIG. 2

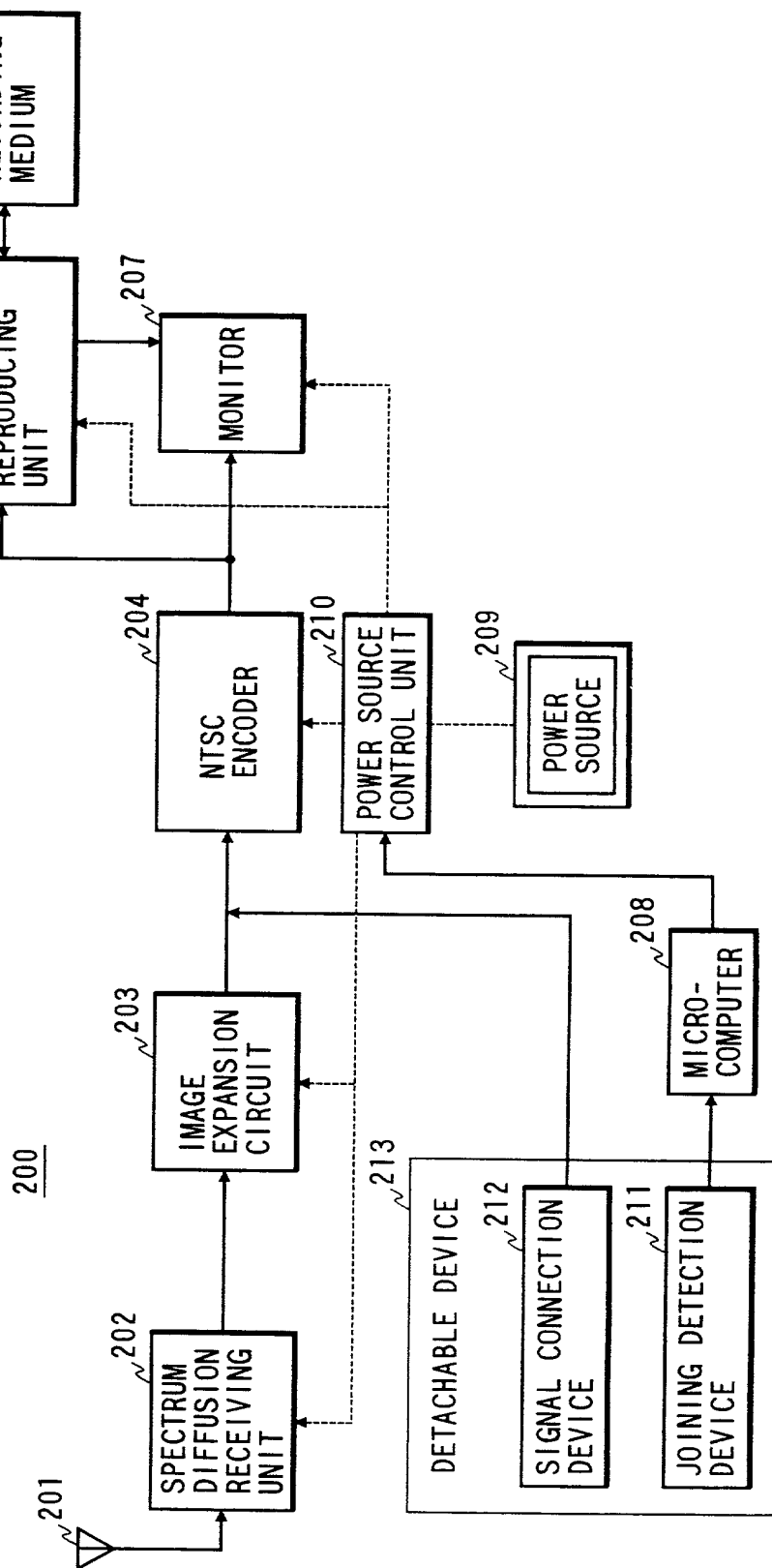


FIG. 4

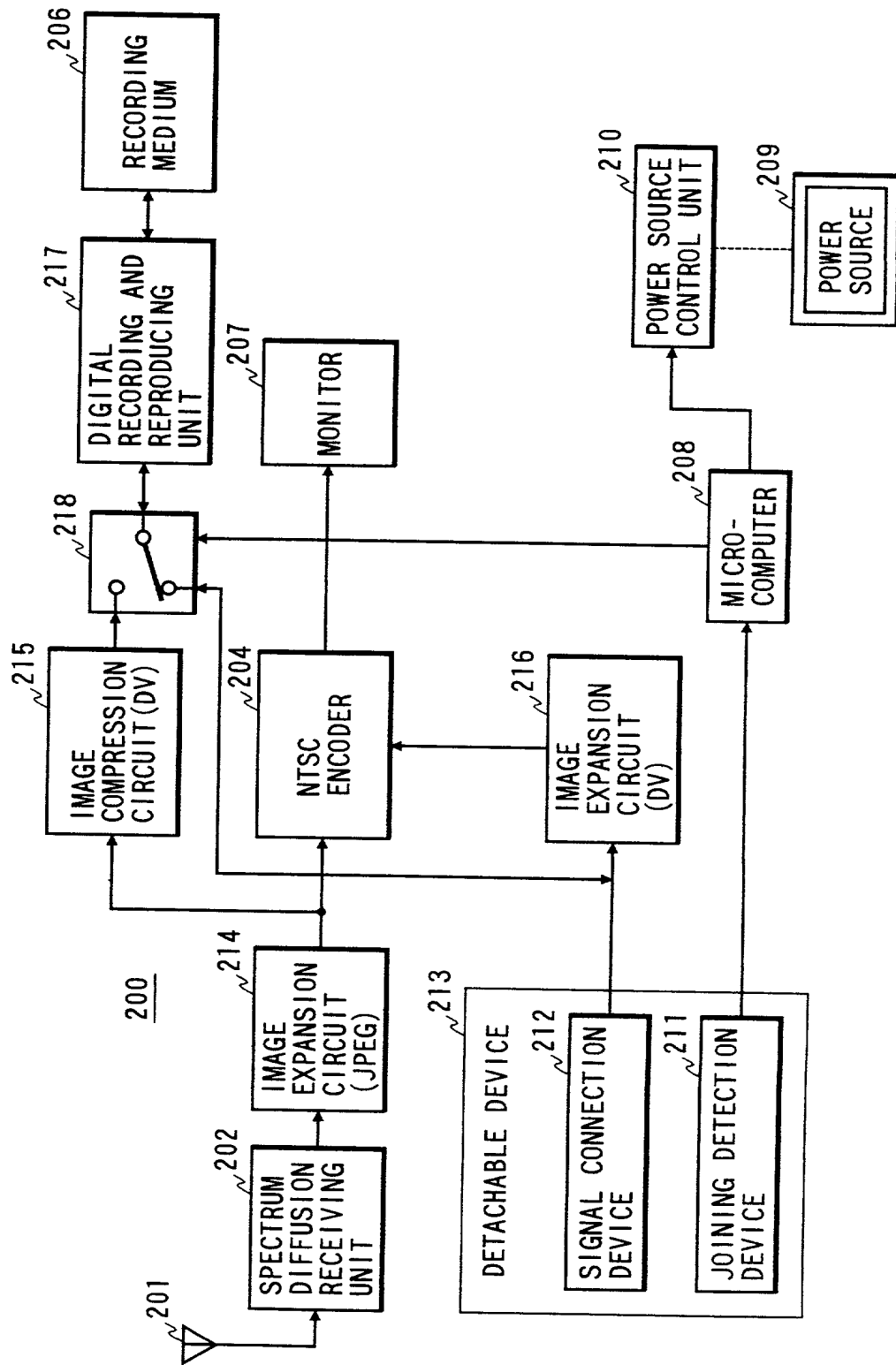


FIG. 5

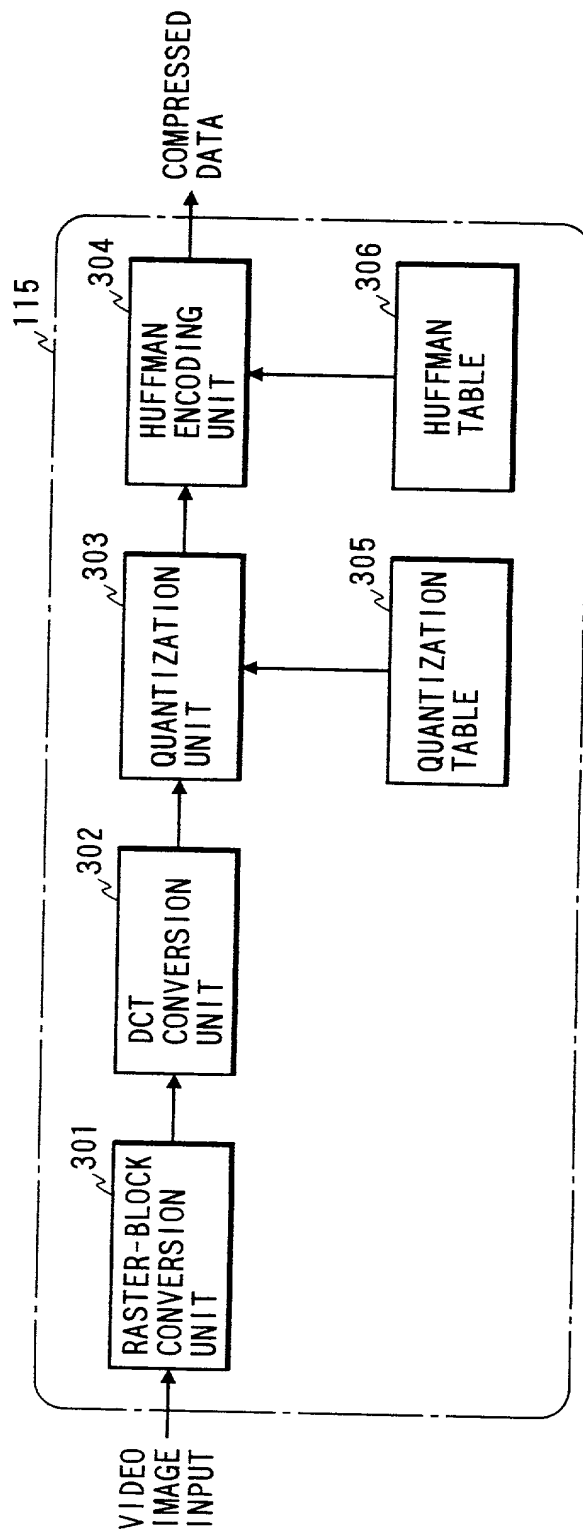


FIG. 6

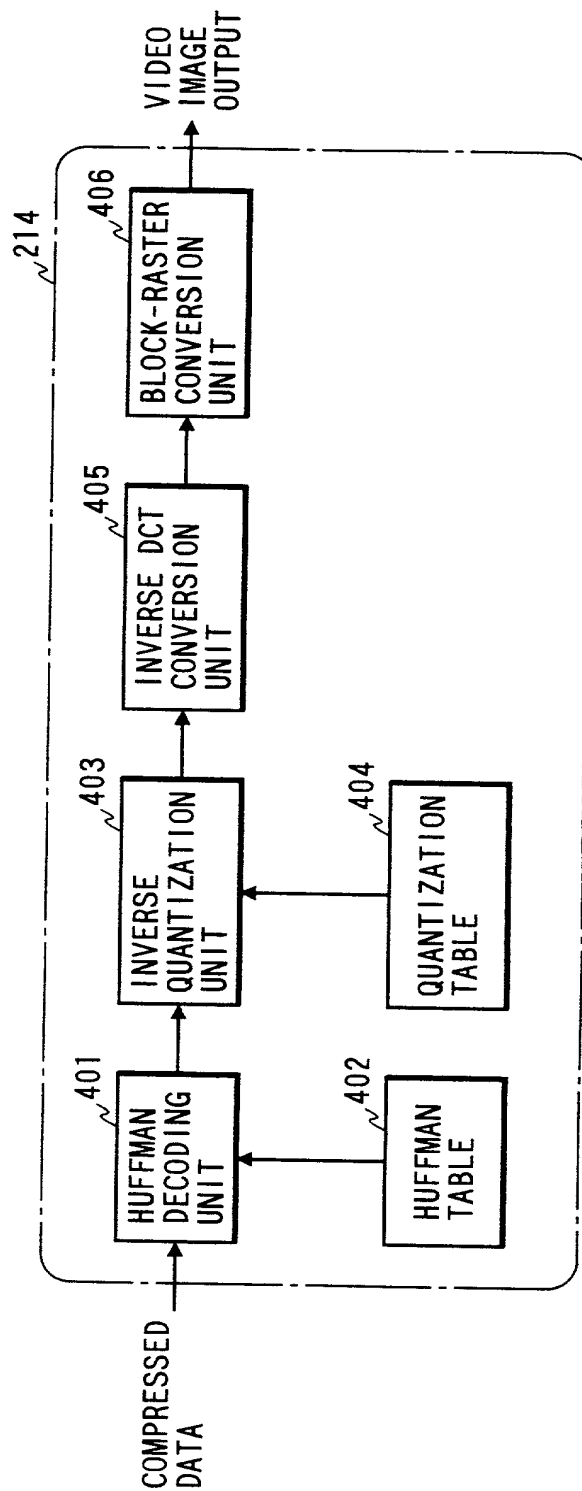


FIG. 7

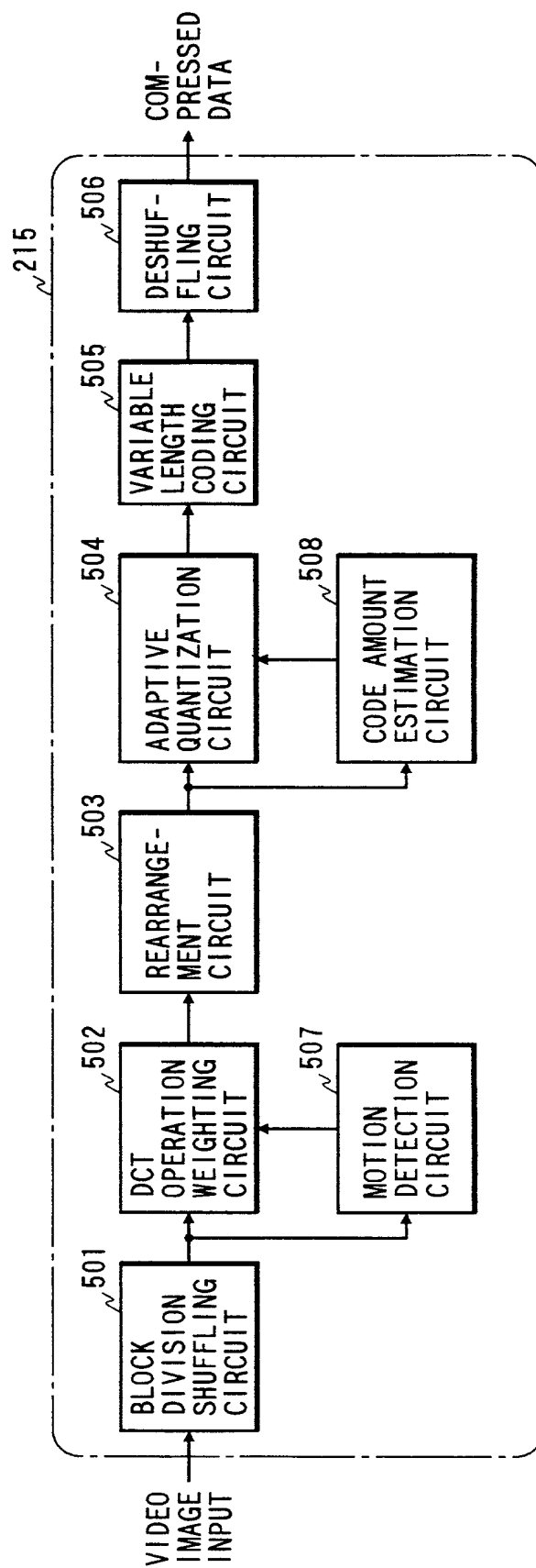


FIG. 8

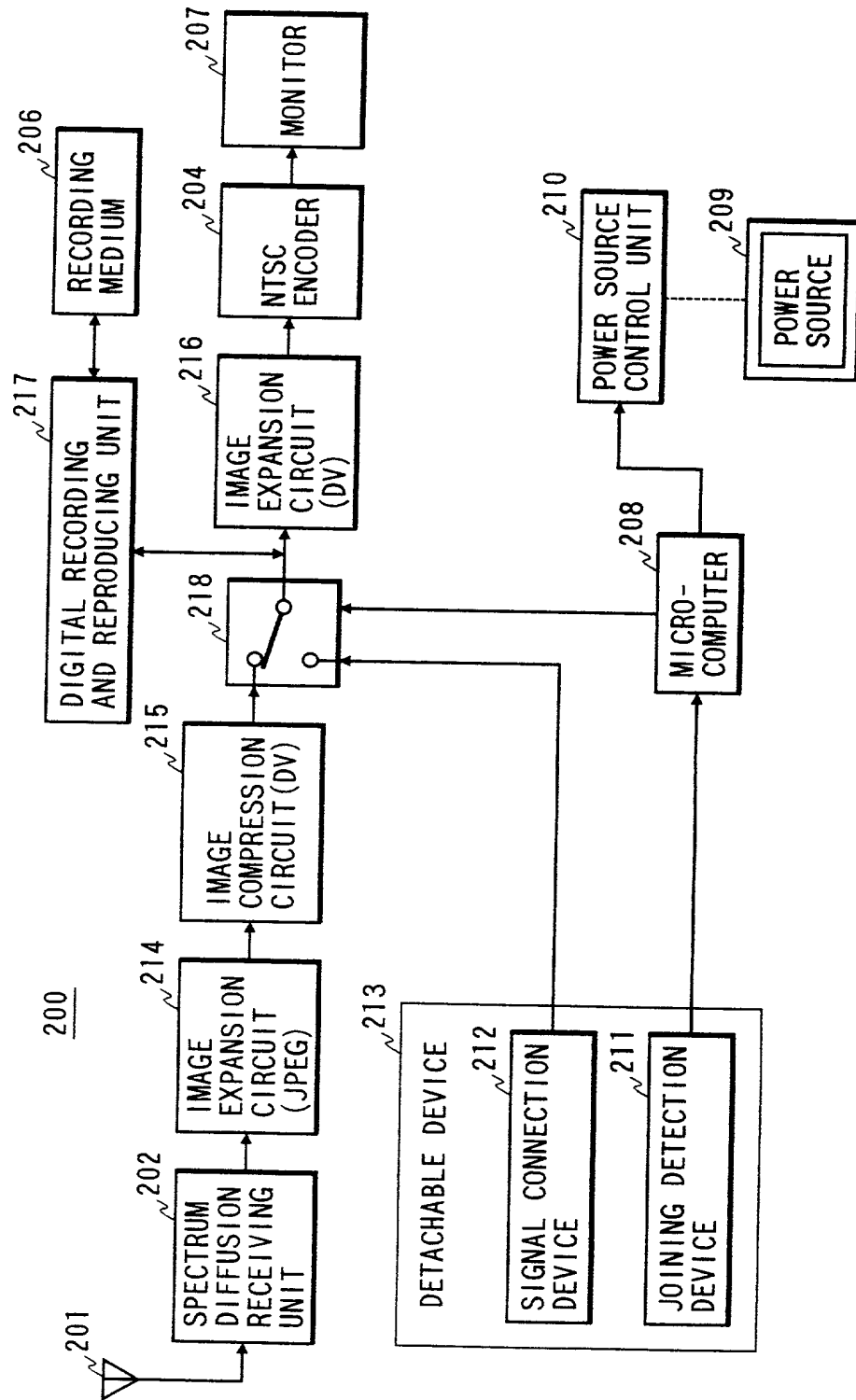


FIG. 9

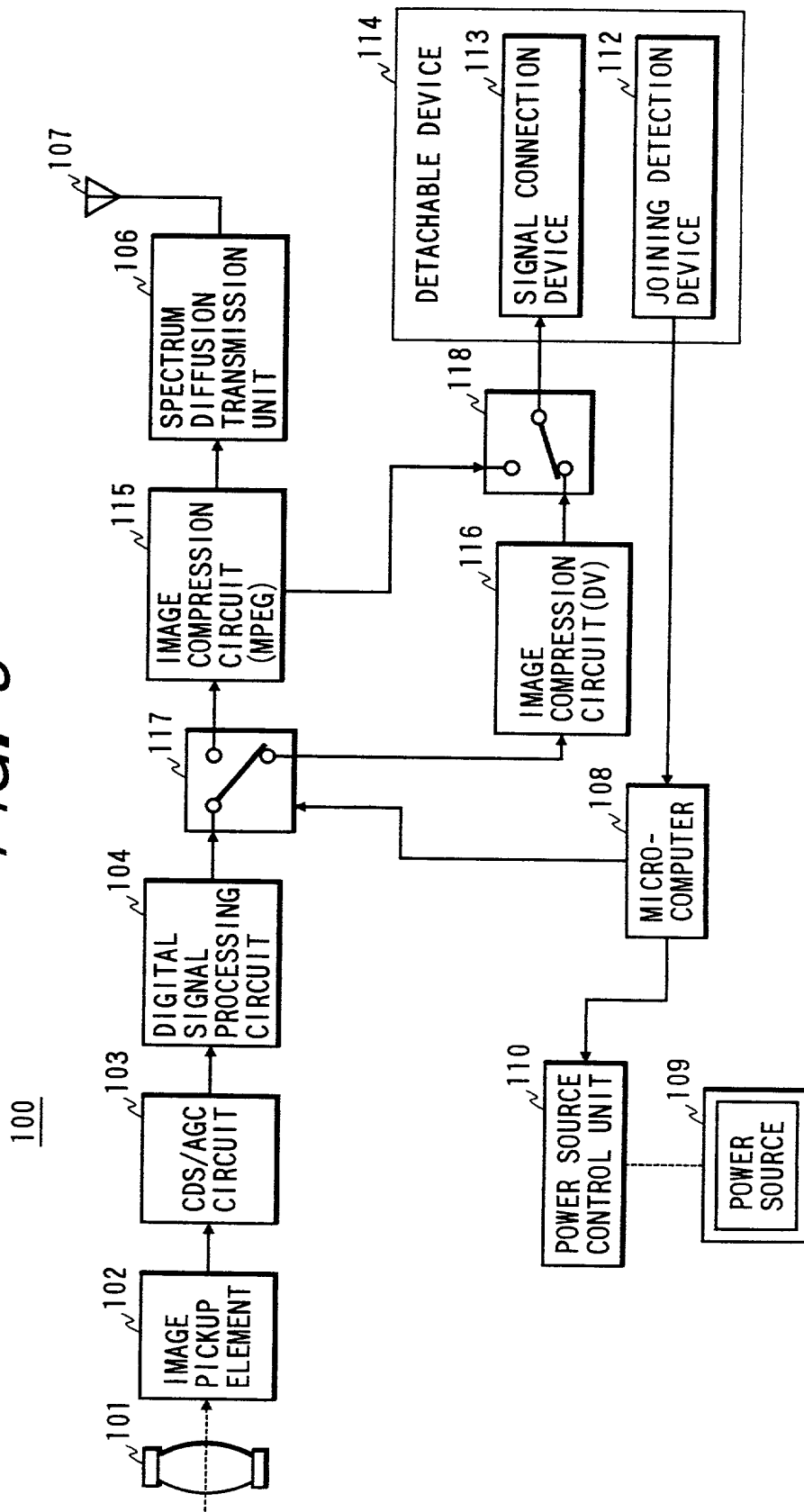
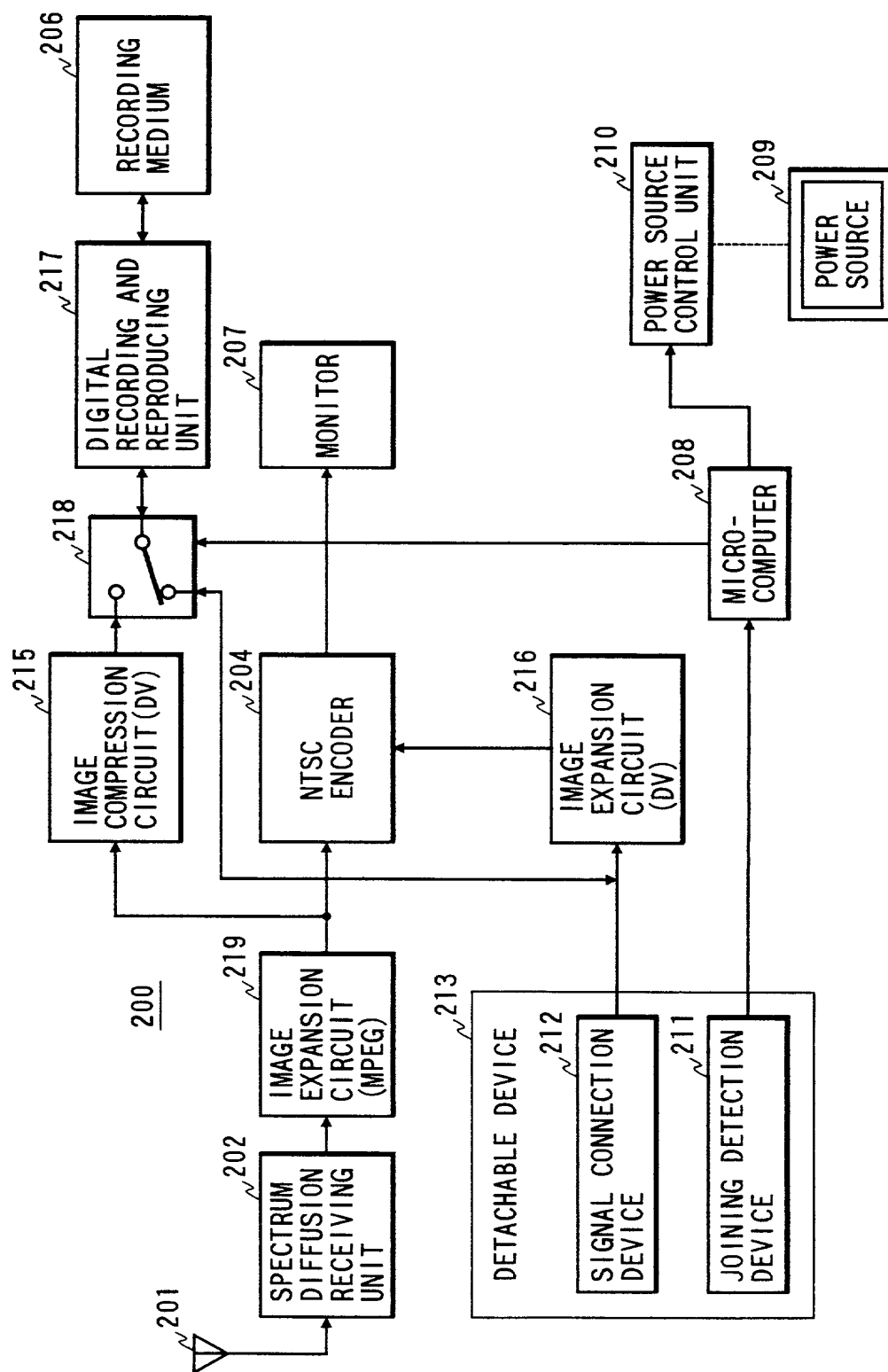


FIG. 10



```
graph LR
    subgraph 119
        801[INFORMATION SOURCE ENCODER]
        802[VIDEO SIGNAL MULTIPLEXING ENCODER]
        803[TRANSMISSION BUFFER]
        804[ENCODING CONTROLLER]
    end
    804 -- "INSTRUCTION OF VARIATION OF INFORMATION GENERATION AMOUNT" --> 801
    804 -- "INSTRUCTION OF VARIATION OF INFORMATION GENERATION AMOUNT" --> 802
    801 --> 802
    802 --> 803
    803 --> CD[COMPRESSION DATA]
    804 -- "BUFFER CAPACITY" --> 803
```

FIG. 12

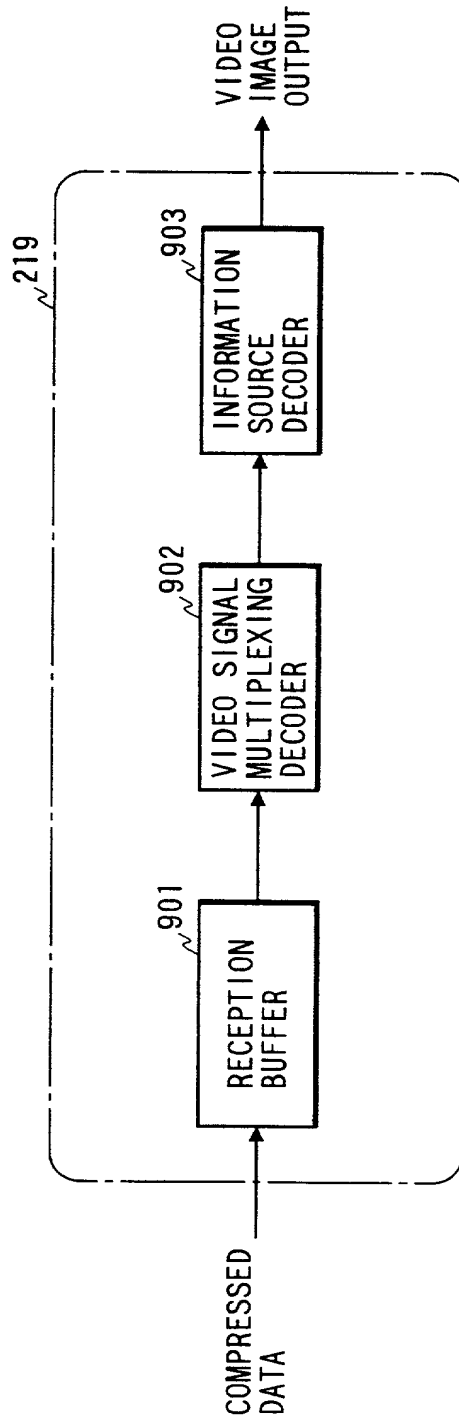
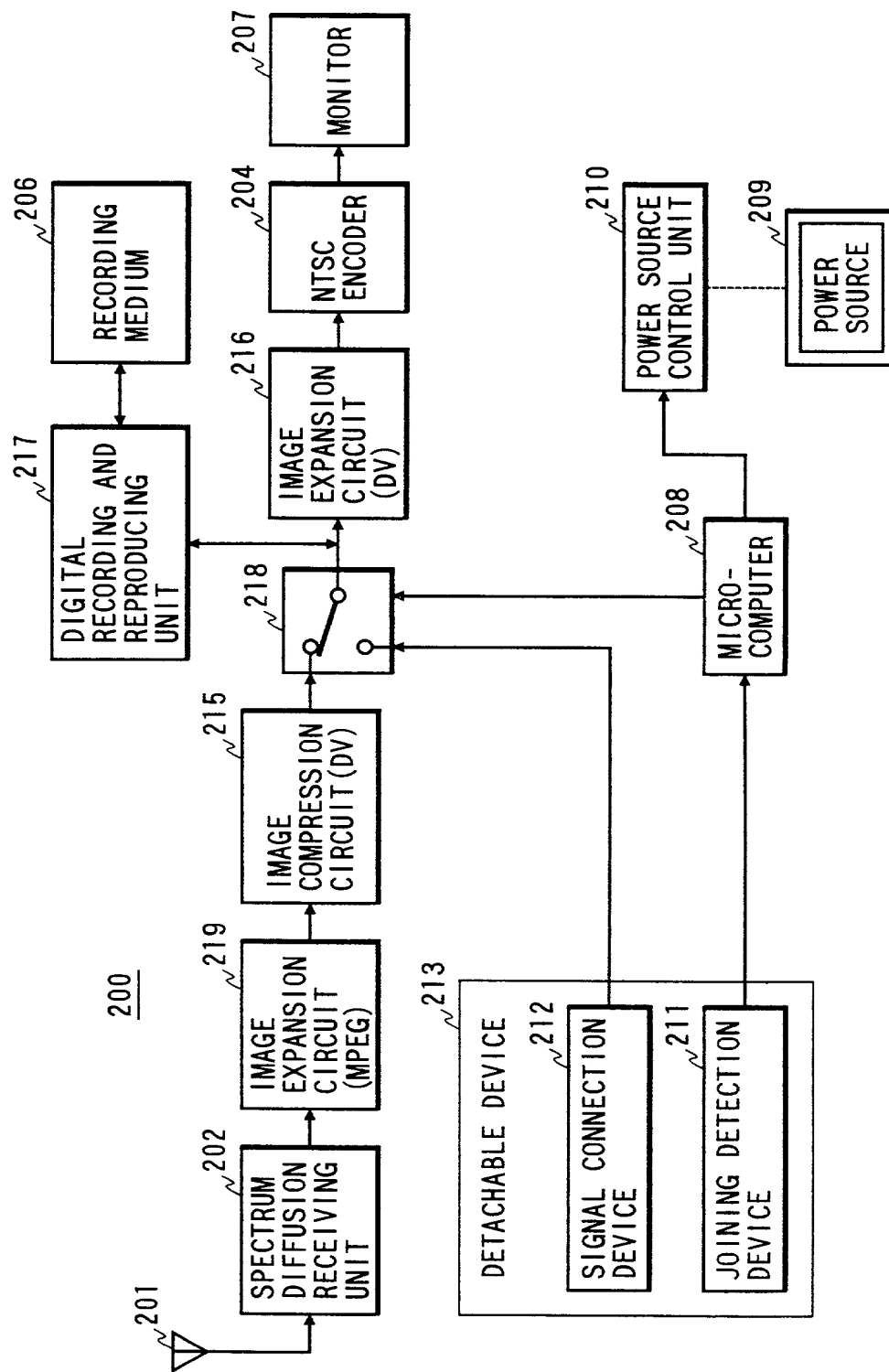


FIG. 13



COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled IMAGE PICKUP SYSTEM WITH SEPARABLE/ATTACHABLE IMAGE PICKUP DEVICE AND DISPLAY DEVICE

_____, the specification of which
☐ is attached hereto. ☒ was filed on April 30, 1997 as Application
No. 08/841,564

and was amended _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Country	Application No.	Filed (Day/Mo./Yr.)	Priority Claimed (Yes/No)
JAPAN	8-116479	10 May 1996	Yes
JAPAN	9-062892	17 March 1997	Yes

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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